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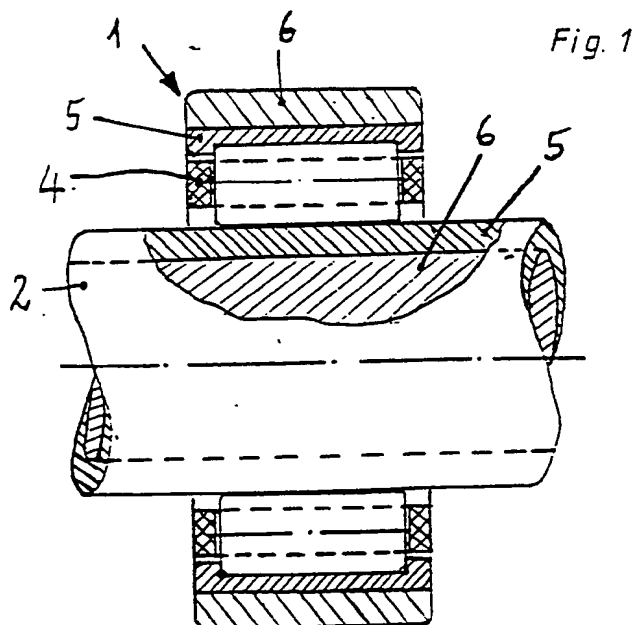
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(54) **Rolling bearing race members and rollers**

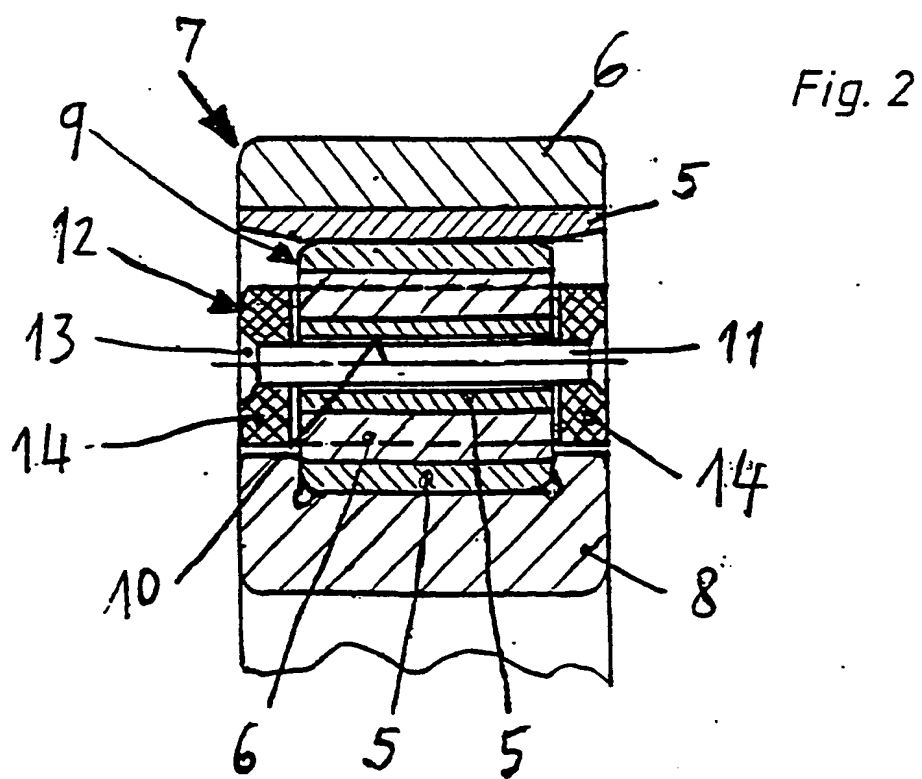
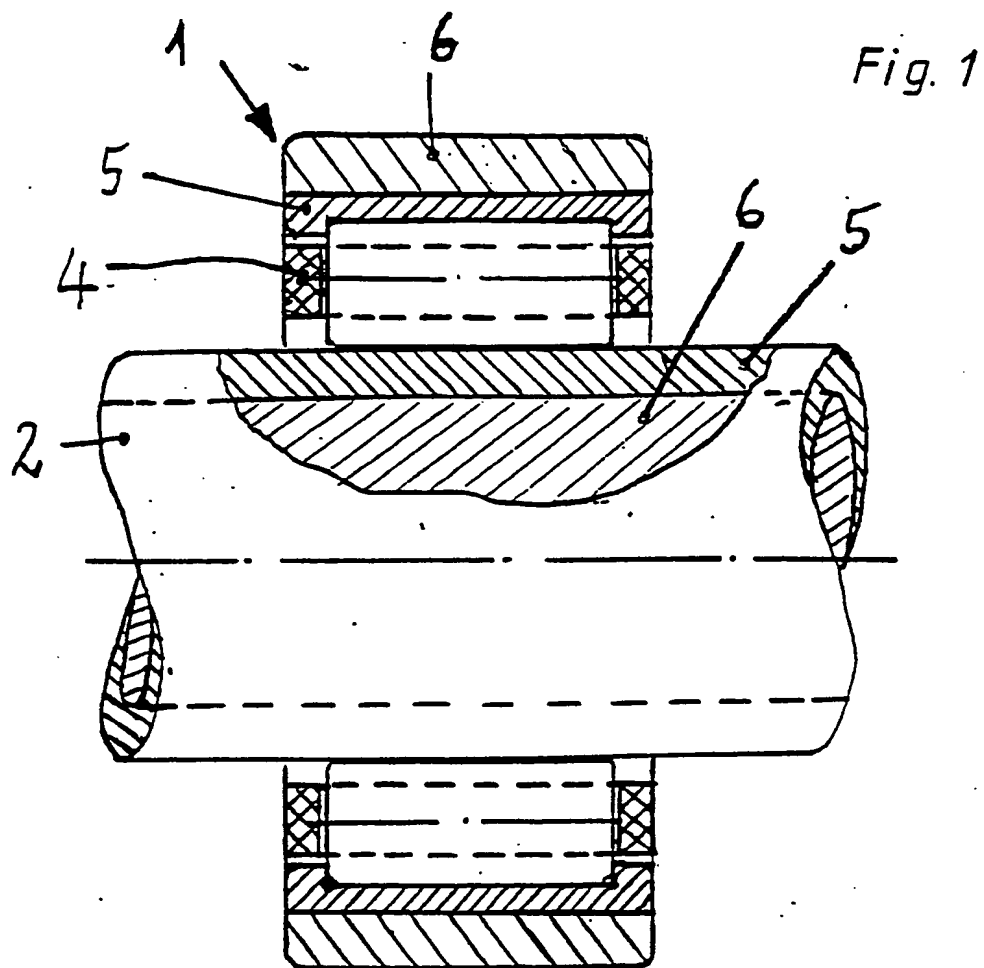
(57) A rolling-bearing race member 1, 2 comprises a supporting member 6 of low-alloy steel and at least one race ring 5 of through-hardening rolling-bearing steel. The supporting member is rigidly connected to the race ring or rings by pressing on and/or shaping to form a one-piece race member. This race member is subsequently heated to a hardening temperature, held at this temperature for the austenizing of the rolling-bearing steel of the race ring or rings, and finally quenched in oil, salt or water to achieve a martensitic structure of the rolling-bearing steel with a hardness of 58 to 64 HRC.

In order that the finished race member may have little residual stress in the transition region, a steel having a carbon content of 0.15 to 0.40% is used for the supporting member, which steel is likewise austenized when the race member is held at the hardening temperature and is likewise converted into a martensitic structure when the race member is quenched.

Hollow bearing rollers can be made by a similar method.



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METHOD OF PRODUCING ROLLING-BEARING ELEMENTS

The present invention relates to a method of producing rolling-bearing elements having a supporting member of low-alloy steel and at least one race ring of through-hardened rolling-bearing steel, wherein the supporting member is rigidly connected to the race ring or rings by pressing on and/or shaping to form a one-piece rolling bearing element, and the rolling bearing element is heated to a hardening temperature and kept at this temperature for the austenizing of the rolling-bearing steel of the race ring or rings and is subsequently quenched in oil, salt or water in order to achieve a martensitic structure of the rolling-bearing steel of the race ring or rings with a hardness of 58 to 64 HRC.

In a known method of the said kind, the materials of supporting member and race ring of a rolling-bearing outer ring are so selected that, during the hardening, the race ring experiences a greater increase in volume than the supporting member surrounding it (DE-PS 27 45 527). An important disadvantage of this known method is that, because of the greater increase in volume of the race ring, high residual stresses are produced at the transition from the race ring to the supporting member and can impair the accuracy of the shape of the rolling-bearing outer ring and its rolling fatigue capacity.

To this must be added the fact that, with the known method, only the outer ring can be produced, but not the associated inner ring and/or the associated rolling bodies of a rolling bearing. In a rolling-bearing element with a race ring disposed on a peripheral

surface of the supporting member, the race ring, which expands to a greater extent during the hardening, would actually become detached from the supporting member. The aim, however, is to equip bearing inner rings or the rolling bodies of a rolling bearing with a hardened race ring of rolling-bearing steel also.

As opposed to this, an object of the present invention is to improve the method of producing rolling-bearing elements of the said kind in the sense that it can be used for the production of rolling-bearing elements of any form. In addition, the rolling-bearing elements produced by this method should have few residual stresses in the region of the transition from the race ring to the supporting ring.

According to the present invention there is provided a method of producing a rolling bearing element having a supporting member of low-alloy steel and at least one race ring of through-hardened rolling-bearing steel, wherein the supporting member is rigidly connected to the race ring or rings by pressing on and/or shaping to form a one-piece rolling bearing element, and the rolling bearing element is heated to a hardening temperature and kept at this temperature for the austenizing of the rolling-bearing steel of the race ring or rings and is subsequently quenched in oil, salt or water in order to achieve a martensitic structure of the rolling-bearing steel of the race ring or rings with a hardness of 58 to 64 HRC, characterised by the use of a steel with a carbon content of 0.15 to 0.40% by weight for the supporting member which, when the rolling-bearing element is kept at the hardening temperature, is likewise austenized and when the rolling-bearing element is quenched is likewise converted into a

martensitic structure.

With a method according to the invention, only the race ring of the rolling-bearing element needs to be made of an expensive through-hardening rolling-bearing steel, for example 100 Cr 6, while the supporting member can be produced from a cheaper steel. During hardening of the rolling-bearing element, not only each race ring but also the associated supporting member experiences a growth in volume as a result of the joint austenizing, and the growth is substantially equal in magnitude. In this manner, only slight residual stresses caused by structural transformation occur at the transition from the race ring to the supporting member during the hardening. Accordingly, the race ring may also be thin-walled in construction so that it may have a considerably smaller weight relative to the associated supporting member.

Because of the uniform growth in volume of race ring and supporting member during the hardening of the rolling-bearing element, the race ring can also be disposed on a peripheral surface of the supporting member without there being the risk of the race ring coming detached from the supporting member during the hardening of the rolling-bearing element. Thus any form of rolling-bearing element, for example the inner ring, the outer ring and/or the rolling bodies of a rolling bearing, can be produced by the method according to the invention.

Advantageous further developments of the invention are characterised in the sub-claims.

With the measure according to Claim 7, a particularly intimate

connection of the race ring or rings to the associated supporting member is achieved because the metallic layer diffuses into the steel of the race ring or rings and of the supporting member at the mutual interfaces during the pressing on and/or during the shaping of the supporting member with the race ring and also during the subsequent hardening of the rolling-bearing element.

The invention will now be described, by way of example, with reference to the accompanying drawings, in which:-

Figure 1 is a longitudinal section through a rolling bearing with an outer rolling-bearing element and an inner rolling-bearing element, both of which are produced by a method according to the invention; and

Figure 2 is a longitudinal section through a modified rolling bearing with an outer rolling-bearing element and rolling rolling-bearing elements which are produced by a method according to the invention.

In Figure 1, a rolling bearing has an annular outer rolling-bearing element 1 and an inner rolling-bearing element 2 constructed in the form of a machine shaft. Disposed between the outer rolling-bearing element 1 and the inner rolling-bearing element 2 are cylindrical rollers which serve as rolling rolling-bearing elements 3 and which are installed in an annular pocket cage 4 of plastics material and rotate in the circumferential direction in operation.

The outer rolling-bearing element 1 and the inner rolling-bearing element 2 each consist of a race ring 5 of through-hardened rolling-bearing steel and a supporting member 6 of a low-alloy steel.

In Figure 2, a modified rolling bearing has an annular outer

rolling-bearing element 7, an annular inner rolling-bearing element 8 and cylindrical rolling-bearing elements 9 in between.

In the present case, the rolling-bearing elements 9 have a central bore 10 passing through them axially. A pin 11 of a cage 12 extends through the bore 10 of each rolling-bearing element 9. Each pin 11 is rigidly connected, at each end, to a lateral disc 14 of the cage 12 by riveting 13. The pins 11, which are engaged in the bore 10 of the associated rolling-bearing element 9 with slight sliding play, guide the rolling-bearing elements 9 at the circumference of the rolling bearing with mutual spacing.

The outer rolling-bearing element 7 has a race ring 5 of a through-hardened rolling-bearing steel which is hot-rolled onto an annular supporting member 6 a low-alloy steel.

The rolling rolling-bearing elements 9 comprise an annular supporting member 6 which carries a cylindrical race ring 5 of through-hardened rolling-bearing steel both on its peripheral surface and in its central bore. The supporting member 6 of the rolling-bearing elements 9 is again made of a low-alloy steel.

Both the rolling-bearing elements 1 and 2 of the rolling bearing illustrated in Figure 1 and the rolling-bearing elements 7 and 9 of the modified rolling bearing shown in Figure 2 have a supporting member 5 of a low-alloy steel with a carbon content of 0.15 to 0.40% by weight, for example the steel grade 28 Mn 6. Each supporting member 5 carries at least one race ring 6 which may be produced from through-hardened rolling-bearing steel of the grade 100 Cr 6. Each of the rolling-bearing elements 1, 2, 7 and 9 is produced by the following

method according to the invention:

- Pressing on and/or shaping of the supporting member 6 with the race ring or rings 5 so that the supporting member 6 and the race ring or rings 5 are rigidly connected to form a one-piece rolling-bearing element 1, 2, 7 or 9, respectively. The shaping is effected in a cold or hot state of the race ring 5 and/or the supporting member 6. After the pressing on and/or shaping, each race ring 5 rigidly connected to the supporting member 6 in one piece may have a wall thickness of 2 to 10 mm.

- Heating the rolling-bearing element 1, 2, 7 or 9 to a hardening temperature, for example 850°C .

- Holding the rolling-bearing element 1, 2, 7 or 9 at a hardening temperature for austenizing both the rolling-bearing steel of the race ring or rings 5 and the low-alloy steel of the supporting member 6. The holding time for this may be about 1 hour.

- Quenching the rolling-bearing element 1, 2, 7 or 9 in oil, salt or water so that the rolling-bearing steel of the race ring or rings 5 acquires a martensitic structure with a hardness of 58 to 64 HRC and the associated supporting member 6 likewise acquires a martensitic structure. In the course of this, the supporting member 6 may assume a hardness of about 40 HRC.

After quenching, the rolling-bearing element 1, 2, 7 or 9 respectively is usually again heated to 160 or 240°C , preferably 180°C and tempered at this temperature with a holding time of 1 to 4 hours, preferably 2 hours.

The rolling-bearing elements are finally finish-ground and, where

appropriate, honed and polished on the tracks of their race rings 5.

If a hot shaping of the supporting member 6 together with the race ring 5 is provided for the production of the rolling-bearing element 1, 2, 7 or 9, this may appropriately be effected by hot rolling.

For a particularly firm connection of the race rings 5 to the supporting member 6 it may be advisable, in many cases, for each race ring 5 and/or the associated supporting member 6 to be coated with a thin metallic layer before the pressing on or shaping. During the hardening of the rolling-bearing element, the metal of the layer diffuses, at the transition point, both into the rolling-bearing steel of the race ring or rings 5 and into the steel of the supporting member 6. The metallic layer, which may consist of copper, is best applied electrolytically so that it has a thickness of 1 to 2 microns.

A steel of the grade 28 Mn 6, which has the following analytical values, expressed as percentages by weight, may be used for the supporting member 6:

C	0.25 - 0.32
Mn	1.40 - 1.65
Si	≤0.40
S	≤0.035,

the remainder being iron and impurities due to the smelting.

CLAIMS:

1. A method of producing a rolling bearing element having a supporting member of low-alloy steel and at least one race ring of through-hardened rolling-bearing steel, wherein the supporting member is rigidly connected to the race ring or rings by pressing on and/or shaping to form a one-piece rolling bearing element, and the rolling bearing element is heated to a hardening temperature and kept at this temperature for the austenizing of the rolling-bearing steel of the race ring or rings and is subsequently quenched in oil, salt or water in order to achieve a martensitic structure of the rolling-bearing steel of the race ring or rings with a hardness of 58 to 64 HRC, characterised by the use of a steel with a carbon content of 0.15 to 0.40% by weight for the supporting member which, when the rolling-bearing element is kept at the hardening temperature, is likewise austenized and when the rolling-bearing element is quenched is likewise converted into a martensitic structure.

2. A method according to Claim 1, characterised in that, during quenching of the rolling-bearing element, the steel of the supporting member is brought to a hardness of about 40 HRC.

3. A method according to Claim 1 or 2, characterised in that the rolling-bearing element is austenized at a hardening temperature of about 850°C.

4. A method according to any one of the preceding claims, characterised in that, after being quenched, the rolling-bearing element is heated to 160 to 220°C and is tempered at this temperature with a holding time of 1 to 4 hours.
5. A method according to any one of the preceding claims, characterised in that the connection of each race ring to the supporting member to form a rolling-bearing element is effected by hot rolling.
6. A method according to any one of the preceding claims, characterised in that during the connection of the supporting member to the race ring or rings by pressing on and/or shaping to form a rolling-bearing element, each race ring is given a wall thickness of 2 to 10 mm.
7. A method according to any one of the preceding claims, characterised in that before the pressing on and/or shaping to form a one-piece rolling-bearing element, the race ring and/or the supporting member is or are coated, at least at their mutual interfaces, with a thin metallic layer which, during the hardening of the race ring or rings and of the supporting member, diffuses into the rolling-bearing steel of the race ring or rings and into the steel of the supporting member.
8. A method according to Claim 7, characterised in that the metallic layer is electrolytically applied.

9. A method according to Claim 7 or 8, characterised in that the metallic layer is copper.

10. A method according to any one of the preceding claims, characterised in that a steel having the following analytical values, expressed as percentages by weight, is used for the supporting member:

C 0.25 - 0.32

Mn 1.30 - 1.65

Si ≤ 0.40

S ≤ 0.035 ,

the remainder being iron and impurities due to smelting.

11. A method of producing a rolling bearing element substantially as hereinbefore described with reference to, and as illustrated in, the accompanying drawings.

12. A rolling bearing element produced by a method according to any one of the preceding claims.